

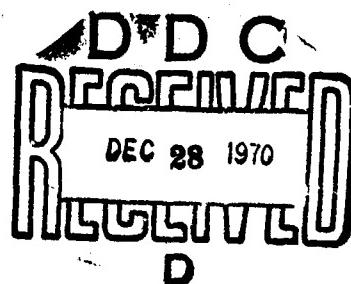
AD718974

AFAL-TR-70-227

REQUIREMENTS FOR REPORTING PERFORMANCE
DATA ON RESEARCH AND DEVELOPMENT CONTRACTS

Prepared for:

Air Force Special Projects Production Facility
Westover Air Force Base
Chicopee, Massachusetts



Prepared by:

Peat, Marwick, Mitchell & Co.
One Boston Place
Boston, Massachusetts

This document has been approved
for public release and sale.
Distribution is unlimited.

August 1970

Distribution of this document
is unlimited

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
Springfield, Va. 22151

b7g

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
I INTRODUCTION	1
Study Objectives	1
Study Scope	2
Study Approach	2
II SUMMARY OF FINDINGS	4
Cost and Schedule Reporting Requirements	4
Technical Performance Reporting Requirements	4
Management Information System Requirements	4
III SUMMARY OF RECOMMENDATIONS	5
Cost and Schedule Reporting Recommendations	5
Technical Performance Reporting Recommendations	6
Management Information System Recommendations	7
IV COST AND SCHEDULE REPORTING RECOMMENDATIONS	9
Statement of the Problem	9
Objective	10
Approach	10
Recommendations	13
Steps Required for the Implementation of the DID's	23

TABLE OF CONTENTS (Cont.)

<u>Section</u>		<u>Page</u>
V	TECHNICAL PERFORMANCE REPORTING REQUIREMENTS	28
	Statement of the Problem	28
	Objective	29
	Approach	29
	Recommendations	30
	Implementation	34
VI	MANAGEMENT INFORMATION SYSTEM RECOMMENDATIONS	37
	Statement of the Problem	37
	Approach	38
	Objective	39
	Recommendations	39
VII	SUPPLEMENTARY RECOMMENDATIONS	48
<u>Appendix</u>		
A	DATA ITEM DESCRIPTIONS	51

I. INTRODUCTION

During the past year, Air Force Special Projects Production Facility (AFSPPF) management personnel and, in particular, the management operations group, have undertaken efforts to improve contractor reporting. In April 1970, Peat, Marwick, Mitchell & Co. (PMM&Co.) was retained to assist in this effort. PMM&Co.'s study was directed at helping AFSPPF improve its capability for managing research and development (R&D) projects by improving its requirements for reporting contractor performance data. This final report is the product of the study and presents PMM&Co.'s recommendations for improving contractor reporting of performance data and the use of that data by the facility.

Study Objectives

The PMM&Co. study was directed at the following objectives:

- identify opportunities for improvement of contractor data reporting for R&D projects;
- recommend specific reporting requirements to capitalize on the opportunities identified; and
- identify and recommend methods for handling the data that will result from the implementation of the new reporting requirements.

The major criterion considered by PMM&Co. in making specific recommendations for contractor reporting requirements was what data is needed by AFSPPF contract monitors to support management decision-making. Additional criteria that served as further constraints on PMM&Co.'s efforts were that the recommendations be implementable in the facility's environment and that they be cost effective for use on small projects, where the addition of a significant administrative burden would be undesirable.

Implementation of improved contractor data reporting requirements should benefit the facility by providing better overall management of the R&D effort through better and more complete data for management decision-making. More specifically, the data will:

- provide more visibility into the contractor's operations and his progress;
- tend to prevent surprises to the government by the contractor, such as unexpected overruns; and
- identify problems early in a program to provide AFSPPF management adequate time for corrective action and a greater range of feasible alternatives for such action.

PMM&Co. believes that the objectives stated above have been met and if the recommendations are implemented these benefits will be obtained.

Study Scope

The scope of PMM&Co.'s investigations under this contract involved the R&D activities of AFSPPF, and, in particular, the facilities management of R&D contracts. The study involved review of and recommendations concerning contractor cost, schedule, and technical performance data. Further, efforts were directed at examining how the acquired data is used to support the facility's management decisions in the R&D area.

Study Approach

The study was performed in approximately four months; i.e., April to August of 1970. PMM&Co. worked in conjunction with AFSPPF personnel and, in particular, with AFSPPF management operations personnel. The methodology followed to develop the recommendations included in this report is described in the following steps:

- AFSPPF R&D contract files were reviewed to determine the size and nature of the R&D projects.

- Existing contractor reporting requirements and actual contractor reports were reviewed.
- The contract monitors were interviewed to determine their needs.
- Tentative recommendations were developed by PMM&Co. based on the steps above. These recommendations were supplemented by sample report formats and sample Data Item Descriptions (DID).
- The recommendations and samples were discussed with the contract monitors and AFSPPF management personnel.
- The results of these interviews were considered in preparing the final recommendations.

PMM&Co. believes that the recommendations contained in this report were received with a high degree of approval and enthusiasm by the contract monitors and AFSPPF management personnel. The remaining sections of this report delineate, in detail, the results of PMM&Co.'s study for AFSPPF.

II. SUMMARY OF FINDINGS

This section summarizes PMM&Co.'s identification of the status of contractor data reporting and the use of that data as it existed at AFSPPF during this study.

Cost and Schedule Reporting Requirements

Contractors, in many instances, are not presently submitting detailed plans of their efforts to AFSPPF for review and approval. Further, those contractor plans that are used are frequently changed without clear identification of the reason for or magnitude of the change. Hence, there is often no framework within which to evaluate contractor performance data.

At the present time, no formalized methods of relating the value of work performed by a contractor to the actual costs to date of that work exist.

Existing Air Force data reporting formats are not closely suited to AFSPPF data requirements.

Technical Performance Reporting Requirements

Technical performance management of contractor efforts is performed by AFSPPF personnel on a personal interaction basis. However, this interaction is limited by the monitor's workload, the technical complexity of the efforts involved, and the geographic dispersion of the facility's contractors.

Management Information System Requirements

At the present time, contractor performance data is communicated reasonably well within AFSPPF. Hence, there is significant question within the facility about the usefulness of a formalized management information center. However, a more formalized approach to communicating contractual data, emphasizing the technical objective to be met, was felt to be needed by AFSPPF.

III. SUMMARY OF RECOMMENDATIONS

This section summarizes the PMM&Co. recommendations concerning AFSPPF R&D management that are detailed in the following sections of this report.

Cost and Schedule Reporting Recommendations

1. Contractors should be required to submit cost and schedule plans at the beginning of a contract and then report against these plans. Specifically:

- The plans should be submitted to AFSPPF subsequent to contract negotiations for review and approval.
 - Periodic reports should be reviewed against the plans for identification and analysis of variances, and for determination of possible management action.
 - Changes to the plans should be made only when the contract is changed. The changes should be reviewed and approved by AFSPPF personnel.
2. AFSPPF should levy reporting requirements on their contractors that will enable them to determine a measure of "earned value." Specifically:
- Earned value should be used as a way of determining the value of work accomplished for comparison with the actual cost of the work.
 - Two approaches to measuring earned value can be used:
 - task valuation (TV); and
 - milestone costing (MC).

. With the exception of fixed price contracts, TV should be used on most AFSPPF contracts in the R&D area. Milestone costing will be generally less applicable than TV but will still be useful on a number of AFSPPF's smaller cost-reimbursable contracts.

3. A set of "additive" Data Item Descriptions should be used to implement cost and schedule reporting requirements on AFSPPF contracts. These are:

- . R&D Contract Status Report/Narrative;
- . Program Schedule/Milestone Accomplishment;
- . Cumulative Cost Projection/Report;
- . Milestone Costing Plan/Report;
- . Task Valuation Plan/Report.

The R&D Contract Status Report/Narrative would be used on almost all contracts in the R&D area. The subsequent reports would be used for the larger, more complex contracts and would build upon the narrative report. For example, the Task Valuation Plan/Report would incorporate the requirements of the R&D Contract Status Report/Narrative, the Program Schedule/Milestone Accomplishment, and the Cumulative Cost Projection/Report.

4. At the present time, the use of critical path method (CPM) scheduling and reporting of more than one level of detail on AFSPPF contracts is not appropriate. Use of CPM scheduling will be appropriate for certain large hardware development contracts planned by the facility.

Technical Performance Reporting Recommendations

AFSPPF contractors should be required to use Technical Achievement Plans (TAP) on major hardware development projects. Specifically, these plans:

- . will include a detailed listing of equipment performance specifications and interim points at which progress toward the accomplishment of these specifications can be measured.
 - . should be approved by AFSPPF personnel at the beginning of contractual effort.
2. Technical performance reporting against the technical achievement plans should be required.
3. Contractors should be required to perform integrated variance analysis; i.e., variance analysis that looks at cost, schedule, and technical performance variances to identify root problems.
4. Technical achievement plans should be used on study contracts with some modification. In particular, study objectives will be used instead of equipment specifications, and technical achievement events will be review oriented instead of test oriented.

Management Information System Recommendations

1. The contract monitor's full responsibility for meeting the cost, schedule, and technical objectives of a contractual effort should be reaffirmed. This should include changing the designation "contract monitor" to "project engineer" or "project manager."
2. The use of work plans by contract monitors on contracts or technical efforts should be required.
3. A Management Information Notebook (MIN) should be used as a practical alternative to a management information center. Specifically:
 - . the creation of a formal Management Information Center is not recommended due to its inflexibility and the effort required to maintain it.

. the MIN will:

- . include information from work plans on each contract;
- . provide the Commander with the original planning baseline and the current status of each contract; and
- . be easily maintained and flexible.

4. When a number of AFSPPF contracts lead to the same technical objective, planning should be performed on a technical area basis.

IV. COST AND SCHEDULE REPORTING RECOMMENDATIONS

This section, addressed to Paragraph 4.1 of the contract statement of work entitled "Develop Contractor Cost and Schedule Reporting Requirements," presents recommendations for cost and schedule reporting requirements to be met by AFSPPF contractors.

Statement of the Problem

AFSPPF has been faced with a number of cost overruns, schedule delays, and technical problems on R&D contracts that have often been unexpected and of significant magnitude. Since these problems have been "surprises," the opportunity for AFSPPF personnel to take corrective action has been limited. The inability to take corrective action, in conjunction with the magnitude of the problems, has made it difficult for the facility to effectively manage a number of R&D efforts.

One approach to alleviate these problems is to require periodic (e.g., monthly) cost and schedule reporting from contractors, which will make contractual performance visible to the government and provide adequate data for decision-making. However, AFSPPF personnel have stated that they sometimes lack adequate data to evaluate (1) contractor performance on R&D efforts, and (2) the success of the facility's R&D efforts in a specific technical domain. In particular, data has often not been available to support such decisions concerning the:

- . investment of additional funds in a contract encountering technical or cost difficulties;
- . extension of contract completion dates;
- . continuation of investing funds in exploration of a given technical domain;
- . evaluation of contractor performance, including technical efforts and management capabilities; and

- . reorientation of a contractual effort.

Objective

PMM&Co.'s objective was to identify and recommend contractor cost and schedule reporting requirements which would provide data to support the decisions outlined above. To a significant degree, fulfilling this objective involved building upon the reporting requirements that the facility has been implementing in the past year. Existing, altered, or new requirements that were considered were recommended on the basis of their contribution toward meeting the following specific objectives of reporting requirements:

- . to provide early identification of deficiencies in contractor performance;
- . to be relevant to AFSPPF management decisions;
- . to provide visibility into contractor performance (i.e., a periodic report should indicate a problem area, but it will not necessarily provide all the data about the problem);
- . to require a minimum of contractor preparation cost and AFSPPF review time; and
- . to match the detail of reporting with contract dollar size, type (e.g., cost reimbursable, fixed price), technical risk, and criticality to AFSPPF requirements.

Approach

The four elements of contractor cost and schedule reporting considered by PMM&Co. for potential use on AFSPPF contracts were:

- . development of planning baselines;

- . development of a measure of "earned value";
- . development of the reporting recommendations in a manner consistent with Air Force Data Management requirements as described in AFSC/AFLC Manual 310-1, "Management of Contractor Data and Reports"; and
- . use of simplified critical path methodologies (CPM) to develop schedule data, and the reporting of more than one level of detail for large contracts.

Development of Planning Baselines

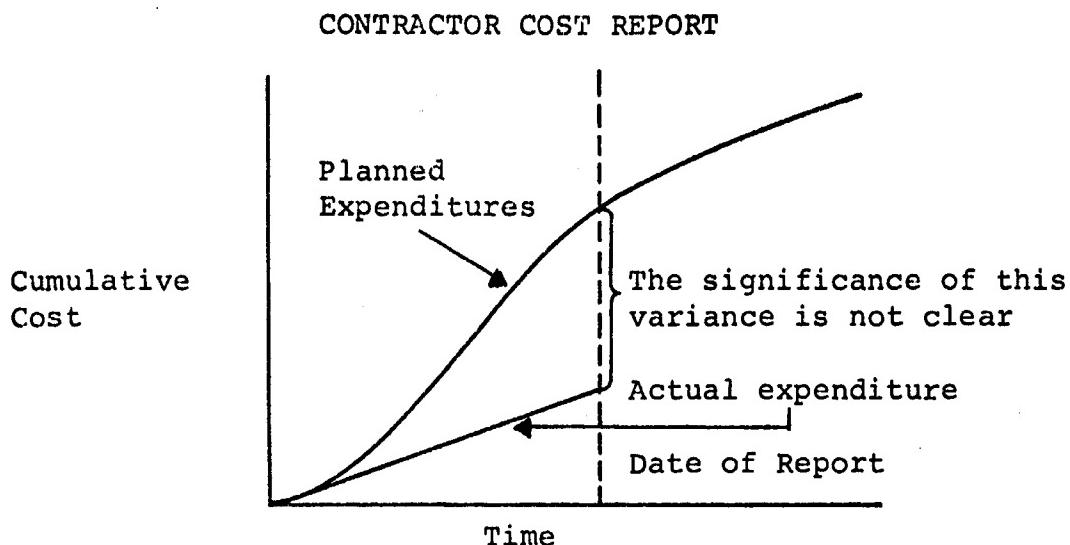
The usefulness of contractor periodic reports is often limited because no baseline plan exists against which to evaluate the reported performance. The fact that a particular milestone was completed during a period has little significance unless the government contract monitor knows when the milestone was supposed to be completed. Hence, PMM&Co.'s efforts to develop reporting requirements considered the need for baseline plans to be reported against.

Development of a Measure of "Earned Value"

Earned value represents a way of associating the value of work accomplished with the actual costs expended on that work to date. Earned value is defined as the originally planned value (or budgeted cost) of the work that has been accomplished, and is measured independently from the actual cost of performing the work. The actual cost of the work is then compared with its budgeted cost (or earned value) to determine whether an overrun or underrun occurred. Earned value represents one way of separating the cost and schedule components of a spending variance.

The need for the earned value approach is demonstrated by the situation presented in Figure 1.

Figure 1



The figure shows actual costs running below planned costs, which implies that the contract is underrunning. However, this situation could be caused by schedule slippages and, hence, not represent a true underrun. In fact, the actual cost curve could be above the projected curve and not indicate a problem if the project was ahead of schedule. Since earned value relates only to the value of the work completed independent of its scheduled or actual completion date, spending variances because of schedule variances are removed from the cost variance.

Development of the Reporting Recommendations in a Manner Consistent With Air Force Data Management Requirements as Described in AFSC/AFLC Manual 310-1

This manual contains the Air Force policies and procedures relating to data management. As such, it gives detailed guidance on the use of DD Form 1664, "Data Item Description," and DD Form 1423, "Contract Data Requirements List." The recommendations made in PMM&Co.'s report are consistent with the requirements of AFSC/AFLC Manual 310-1. Where specific actions are necessary for AFSPPF to meet the manual's requirements, such as gaining approval of certain Data Item Descriptions, they will be described.

Use of Simplified CPM To Develop Schedule Data,
and the Reporting of More Than One Level of
Detail for Large Contracts

On large Department of Defense R&D contracts, PERT CPM and work breakdown structures (WBS) are often used as management tools. PERT CPM is used as a scheduling tool to project the tasks required for contract completion and to relate the interdependencies between these tasks. A work breakdown structure divides a large project into smaller packages. Work planning, reporting, and control are then related to these smaller packages.

Recommendations

The results of PMM&Co.'s efforts to develop cost and schedule reporting requirements for AFSPPF contracts have indicated that (1) the facility should require contractors to submit cost and schedule plans and report against these plans; (2) there are two effective ways of developing a measure of earned value on facility contracts; (3) the required reporting data can be acquired by the facility using a set of reporting formats that meet the requirements of AFSC/AFLC Manual 310-1; and (4) the facility does not, at this time, have contracts for which CPM or a WBS are necessary.

Implementation of the recommendations will be accomplished by using five Data Item Descriptions (DID) that PMM&Co. has written and recommended for the facility's use. Hence, the recommendations discuss the following DID's in detail.

- I. R&D Contract Status Report/Narrative
- II. Program Schedule/Milestone Accomplishment
- III. Cumulative Cost Projection/Report
- IV. Milestone Costing Plan/Report
- V. Task Valuation Plan/Report

These DID's, with sample reports, as appropriate, are written to their specifications and provided in Appendix A.

The following pages contain detailed discussions of PMM&Co.'s cost and schedule reporting recommendations.

Contractors should be required to submit cost and schedule plans at the beginning of a contract and then report against these plans.

Plans should be submitted to AFSPPF subsequent to contract negotiations for review and approval. The periodic reports should be reviewed against the plans for identification and analysis of variances and for determination of possible management action. Changes to the plans should be made only when the contract is changed, and any changes made at this time should be reviewed and approved by AFSPPF personnel.

The facility, on present contracts, usually does not receive a cost or schedule plan from contractors at the beginning of an effort. The plans that are available may have been included in the contractor's proposal or are contained, by implication, in the contractor's first periodic report. However, plans from contractor proposals are not submitted in response to a specific facility requirement and are usually modified by contract negotiations. Periodic reports usually do not contain detailed buildup data and are received well after the start of the contract. Hence, neither of these plans provides a detailed baseline against which variances can be measured and performance evaluated.

The DID's recommended for AFSPPF use provide for the submission of both plans and reports by AFSPPF contractors. The first submission will be a plan, and subsequent submissions will be reports against that plan. For example, the first submission by the contractor for the Program Schedule/Milestone Accomplishment data item would actually be the program schedule, expressed in milestones. Successive reports would then show program progress in the form of milestone accomplishment.

The contractor should not change the original plan unless a contract modification is made. As the effort progresses, some rescheduling and reestimating will occur.

Whenever this happens, the original planning data should always be shown. Otherwise, changes are often not noted and the new plan loses its historical context. Further, if changes occur in cost buildup data, such as overhead rates, these should also be reported.

AFSPPF should levy reporting requirements on their contractors that will enable them to determine a measure of "earned value."

Two ways of obtaining an effective measure of earned value of AFSPPF contracts have been developed and are recommended for facility use. These have been designated Milestone Costing (MC) and Task Valuation (TV) and are provided as DID Forms IV and V. Sample MC and TV reports written to the specifications of the DID's are presented in Appendix A.

TV includes a program schedule showing tasks as a function of time and a subdivision of cost by task. These elements are used in the same manner as in the Program Schedule/Milestone Accomplishment and Cumulative Cost Projection/Report. However, TV relates the cost and schedule data by placing a value (in dollars) on each task. Each reporting period, an estimate of the percent complete of each task is made. The percent complete is then multiplied by the estimated value of the task, giving a measure of earned value for every task in the contract. These task earned values are then added to give a measure of earned value for the entire contract. The earned value is compared with the actual costs incurred to date to evaluate contract cost performance. Schedule status is provided by the milestones that define the tasks.

A tabular example of how this process works is shown on the next page. (The milestones and cumulative expenditures are not given.)

Total Estimated Cost	\$ 250,000
Total Costs Incurred to Date	\$ 175,000

<u>Tasks</u>	<u>Value</u>	<u>% Complete</u>	<u>Earned Value</u>
1	\$40,000	100	\$ 40,000
2	\$60,000	100	60,000
3	\$80,000	70	56,000
4	\$40,000	50	20,000
5	\$30,000	10	<u>3,000</u>
			<u>\$ 179,000</u>

The earned value is \$179,000, which indicates that a \$4,000 underrun on efforts has been incurred to date.

The TV chart shown in DID V in Appendix A has only one column for the earned value data. This column is marked "Percent Complete." When the contractor submits his original plan, he will place the dollar value of each task in this column. The periodic reports will show the percent complete of each task in this column. Only one column is provided on the TV chart for the following reason. If the contractor were to make the earned value calculation, he could be motivated to make the earned value more optimistic by adjusting his percent complete estimates. This possibility can be minimized if the contract monitor performs these calculations.

A worksheet for calculating earned value over the life of a contract is shown in Figure 2. The contract monitor lists the tasks and their value on the left-hand side of the worksheet. As contractor reports are received, the monitor lists the percent complete for each task and calculates its earned value. The total contract earned value would then be entered at the bottom of the chart and compared to the actual cost to that date. Thus, an earned value trend will be developed over the life of the contract.

Milestone costing provides a measure of earned value by associating schedule milestones directly with the projection of cumulative costs. This is done by placing the

TASK VALUATION WORKSHEET	TITLE <i>Spectrum Analyzer</i>	CONTRACTOR <i>XYZ Corp</i>	DATES						MONITOR <i>Joseph Schmidt</i>	TOT. EST. COST <i>\$162,000</i>				
			REPORT DATES											
1	TASKS	5 200's	1/3/70	2/28	3/31	4/30	5/31	6/30	7/31	8/31	9/30	10/31	11/30	12/31
1	Breadboard Design	22	20	1.4	7.5	16.5	100	22						
2	Breadboard Tests	8	0	10	.8	100	8							
3	Equip Interfaces Design	12	0	0	50	6								
4	"A" Equip Schematics	11	0	0	0	25	3.25							
5	"B" Equip Schematics	14	0	0	0	25	4.5							
6	Mechanical Layout	15	0	0	0	25	4.75							
7	Eng Model Fabrication	26	0	0	0	0	0							
8	Blank Tests	8	0	0	0	0	0							
9	Environment / Tests	10	0	0	0	0	0							
10	Subsystem Assembly	11	0	0	0	0	0							
11	Subsystem Tests	7	0	0	0	0	0							
12	System Tests	5	0	0	0	0	0							
13	System Installation	12	0	0	0	0	0							
14														
15														

effort's major milestones directly on the cumulative cost curve, as illustrated by the sample report for DID IV in Appendix A, indicating how much money should have been expended when each milestone is accomplished. The milestones fit on the curve at the proper dates because it is assumed that the cumulative cost curve was developed by estimating the costs for each task and assigning those costs to the time period over which the task is scheduled. If this assumption is not valid, the planning function has not been performed properly and efforts to improve it should be made.

As progress is made on the effort, the contractor reports expenditures and milestone completions. However, he also shows actual milestone accomplishment on the cumulative cost curve, as illustrated in the sample report for DID IV in Appendix A. When one milestone is accomplished, the contractor is credited with an earned value equal to the expected cost at that milestone. This earned value is then compared with the actual cost at that milestone to measure any performance variance.

Milestone costing requires somewhat less effort by the contractor and the contract monitor, because it does not require estimates of percent complete and calculation of earned value. However, it also has a limitation which can reduce its effectiveness. Milestone costing does not place a value on work, or tasks, in progress. Since many of the tasks in an R&D effort are usually overlapping, a number of tasks will be partially complete when any given milestone is accomplished. Efforts on these tasks could have been reduced to complete the present milestone on time and on cost. However, the projected costs at the milestone completion include some costs for other, as yet incomplete, tasks. If these tasks were being underspent, thus disguising an overrun, it would not show on the MC report. Since TV does place a value on tasks in progress, it will be more appropriate for contracts that have significantly concurrent tasks.

One other problem can limit the usefulness of the MC and TV approaches, or any other approach that uses a time-phased plan, to measuring earned value. This

situation is where the original plans are "front-loaded"; i.e., this means that tasks scheduled early in the program are assigned larger than realistic "values" and the later program tasks are assigned smaller "values" to compensate. Performance early in the contract will seem adequate even though an overrun may be occurring. Problems that develop will show up in the later stages of the report where actual costs are compared to the unrealistically low estimates. The AFSPPF contract monitor should carefully review and evaluate the contractor's original plans to ensure that the cost estimates for all tasks are not front-loaded.

A set of "additive" Data Item Descriptions should be used to implement cost and schedule reporting requirements on AFSPPF contracts.

Five basic Data Item Descriptions have been recommended for AFSPPF's use as specific means of implementing PMM&Co.'s cost and schedule recommendations. The data items have been written so that they can be used in "additive" fashion. For example, the R&D Contract Status Report/Narrative could be used by itself on a small contract. For larger contracts that required more sophisticated reporting, additional data items would be used, and the R&D Contract Status Report/Narrative would become the narrative portion of the entire report.

The following pages contain summary descriptions of each of the five DID's with guidelines for their application to contracts.

The R&D Contract Status Report/Narrative can be used by itself or as the textual portion of more sophisticated reports. It specifies the content and organization of the contractor's report with the following outline:

- I. Highlights
- II. Government Actions Required
- III. Technical Performance
- IV. Schedule
- V. Cost
- VI. Contractual

The Program Schedule/Milestone Accomplishment is used to depict the program schedule and report on milestone accomplishments. No cost data is included in this report, so it may be used on fixed-price contracts. This report also contains the basic schedule planning and reporting guidance to be followed when submitting MC and TV reports.

The Cumulative Cost Projection/Report provides the basic means of reporting expected and actual contract costs as a function of time. When the report is used as a plan of contract costs, detailed cost buildup data can be required; e.g., direct labor costs per task, overhead and general and administrative rates, materials costs, etc. The contractor is required to submit estimates to complete each reporting period and any changes that have occurred in his cost buildup data; e.g., overhead rates.

The Milestone Costing Plan/Report represents the means of levying the milestone costing approach to measuring earned value on the contractor. It references the requirements of the milestone reporting and cumulative cost reporting DID's whose requirements should also be met when submitting an MC report. The milestone costing report will always include the R&D Contract Status Report/Narrative as its textual portion.

The Task Valuation Plan/Report represents the means of levying the task valuation approach to measuring earned value on the contractor. As with the Milestone Costing Plan/Report, it includes, by reference, the requirements of the milestone reporting and cumulative cost reporting DID's. The textual portion of the report is provided by the R&D Contract Status Report/Narrative.

The applicability matrix in Figure 3 shows how the different reporting requirements should be applied to various contracts. The major considerations in formulating the matrix are highlighted as follows:

**FIGURE 3
APPLICABILITY MATRIX**

REPORTING REQUIREMENT	R & D CONTRACT STATUS REPORT/NARRATIVE	PROGRAM SCHEDULE / MILESTONE ACCOMPLISHMENT REPORT	CUMULATIVE COST PROJECTION/REPORT	MILESTONE COSTING PLAN/REPORT	TASK VALUATION PLAN/REPORT	TECHNICAL ACHIEVEMENT PLANS & REPORTS
CONTRACT TYPE						
HARDWARE DEVELOPMENT (COST REIMBURSABLE)	always applicable	alone or as part of TV or MC	alone or as part of TV or MC	for smaller, under \$50K, having sequential tasks	may not be necessary on small projects, under \$30K	useful on large contracts, over \$150K, with TAE's should be useful on
SOFTWARE DEVELOPMENT	always applicable	alone or as part of TV or MC	alone or as part of TV or MC	for smaller, under \$50K, having sequential tasks	may not be useful if estimates of % complete are dif. to make	medium-size contracts \$50K - \$150K
STUDY EFFORTS	always applicable	alone or as part of TV or MC	alone or as part of TV or MC	for smaller, under \$50K, having sequential tasks	may not be necessary on small projects, under \$30K	useful in modified form as outlined in text
SERVICE CONTRACTS	always applicable	if schedules exist at contract start	always applicable	NA	NA	NA
OFF-THE-SHELF EQUIPMENT (FIXED PRICE)	used to report sched. & perf. data if item is critical to AFSPPF mission	NA	NA	NA	NA	NA

*specific task work plans should be submitted for AFSPPF approval before work begins on individual tasks.

- . More sophisticated reporting is required for:
 - . a large contract;
 - . a technically complex contract; and
 - . a contract with a great risk of failure to the facility's mission.
- . Fixed-price contracts require no cost reporting.
- . The MC approach tends to be used on contracts with sequential tasks, where the problem of valuing work in process will be minimized.
- . The TV approach is applicable on most cost-reimbursable contracts that have a number of definable tasks and are on the order of magnitude of \$30 thousand or greater.
- . On large service contracts, specific task work plans should be submitted for approval before work begins on individual tasks.

At the present time, the use of CPM scheduling and reporting of more than one level of detail on AFSPPF contracts is not appropriate.

AFSPPF does not have contracts of sufficient size to require the use of work breakdown structures or critical path scheduling data for reports. However, these approaches are potentially useful on one or two of the major hardware procurements planned by the facility in the next few years. If these procurements do materialize, use of CPM by the contractor should be considered as a basis for summary schedule reporting.

Steps Required for the Implementation of the DID's

Implementation of the five recommended DID's requires consideration of three factors:

- the requirements of AFSC/AFLC Manual 310-1;
- the use of the Contract Data Requirements List (DD Form 1423); and
- the potential contractor responses to the data requirements.

AFSC/AFLC Manual 310-1 Requirements

Since the five DID's discussed are not included in the Air Force's Authorized Data List (ADL), which is part of AFSC/AFLC Manual 310-1, they will have to be approved before they can be used as AFSPPF contracts. AFSC/AFLC Manual 310-1 provides for the use of the following three types of nonstandard DID's:

- "U" Data Item Description;
- Modified Data Item Description; and
- R&D Data Item Description.

These are described in Volume I, Pages 1 and 2, of the manual as follows:

- "(2) "U" Data Item Description. A unique (non-standard) DID proposed or approved for use when a data requirement cannot be met by use or modification of a standard Data Item Description. A "U" data item description is intended for limited use only (for example, one time only or until such time as a standard equivalent is incorporated in the ADL).
- "(3) Modified Data Item Description. A standard or approved "U" data item description that meets the general requirements of the data needed but must be modified to comply with

specific program requirements. This modification can only:

- (a) Reduce the scope through deletion of words, paragraphs, or sections.
- (b) Clarify usage where considered necessary.
- (c) Adjust the format to meet program-peculiar requirements within the content and scope of the original data item (for example, use of contractor format). When the format is mandatory, the change must be processed as a "U" DID.
- (d) Cite the acceptability of similar data which will satisfy the Air Force requirement which may have been prepared under the auspices of another Government agency (for example, FAA or Navy).
- (e) Provide for the combination of two related data items in a single report.

"(4) R&D Data Item Description. A DID generated for use when standard Data Item Descriptions will not suffice on research, exploratory development, advanced development, and related studies and support programs, where hardware, equipment, reports, or other data delivered are solely for feasibility or experimental investigations. Within this context, reprocurement or adaptation for operational use is not envisioned or contemplated; otherwise, R&D Data Item Descriptions are to be treated as "U" data items."

Since the facility's procurements are in the R&D area, the recommended DID's should be able to be treated as R&D data items. R&D data items can be approved at the "laboratory level" (see AFSC/AFLC Manual 310-1, Volume I, Page 5.2). Thus, approval for the data items can be obtained from the data management offices at the agencies through which AFSPPF personnel process their procurement actions.

Two of the recommended items (i.e., the R&D Contract Status Report/Narrative and the Program Schedule/Milestone Report) are similar to data items on the ADL (i.e., the R&D Contract Status Report, A-113, and the Program Schedule Report, M-103). Since the recommended data items explain, in detail, the content of the approved data items as opposed to adding to their content, they could be considered as modified data items and not require approval.

Use of the Contract Data Requirements List
(DD Form 1423)

The actual levying of a reporting requirement on a contractor is accomplished through the use of DD Form 1423. This form, which is attached to and is part of the contract, lists the reports to be submitted by the contractor, the timing of submission, number of copies, and other pertinent data. It is important that DD Form 1423 be prepared properly so that the contractor will submit reports as they are required by the government.

Two elements of the information on DD Form 1423 that are particularly important are the timing of report submissions and the relation of the submission of a data item plan to a data item report against that plan. In most cases, the data items recommended should be submitted monthly. However, monthly reports are often received three and four weeks after the close of the month to which they pertain. Such a delay can reduce the value of the information submitted because it is too late to respond to the situation described. Management action contemplated as a result of the late report is often ineffectual because the situation has usually changed significantly. The DD Form 1423 should require that periodic reports be received (or postmarked) by the tenth day of the month following the month covered in the report.

The data items recommended in this report are written so that they will serve as a requirement for a plan and reports against that plan. This stipulation should be made clear in the "remarks" section of DD Form 1423.

The plan should be submitted by the contractor early in the effort, approximately 10 days after the contract start date. The periodic reports should then be submitted monthly against that plan. The first report would cover the first month of contract effort and thus be submitted about 40 days after the plan. If desirable, these approximate times can be varied to meet contractor accounting periods.

Potential Contractor Responses to Data Requirements

When required to submit detailed reports, contractors often place very high costs on the data in the hope that the government will remove the requirement. AFSPPF personnel must be aware of this possibility and have some feel for the cost of a data requirement to the contractor.

None of the DID's recommended in this report should cost the contractor a great deal. Milestone costing requires only that the contractor relate cumulative costs directly to milestones, both of which are common data requirements. The relation between the two should come directly from the contractor's plan.

Task valuation requires the contractor to report his expected costs for each contract task; again, this data should be available in the contractor's plan. In addition, an estimate of the percent complete of each task is required for each report. This estimate is to be made by the person in the contractor's organization directly responsible for accomplishing the work, and is not based on the costs that the contractor is expending on this task. Hence, TV does not place any requirements on the contractor for accumulating costs for each task.

Any data requirements levied by the government and their costs become the subject of negotiation between the government and the contractor. Initial contractor proposals or costs need not be taken as absolute. In particular, care should be taken to closely examine contractors who place a high cost on these data items because they may have something to hide or may have improperly planned their efforts. Since much of the data required

is from plans, the lack of proper planning may be the cause of the high costs. Improper planning is a major cause of contract performance deficiencies and should be eliminated if uncovered during contract negotiations.

V. TECHNICAL PERFORMANCE REPORTING REQUIREMENTS

This section, addressed to Paragraph 4.2 of the contract statement of work entitled, "Develop Technical Performance Reporting Requirements," presents recommendations for the development, by AFSPPF contractors, of technical achievement plans and technical performance reporting against these plans.

Statement of the Problem

The recommendations presented in Section IV for improved cost and schedule reporting are directed, in part, at obtaining a better evaluation of program progress and eliminating surprise overruns. It has been PMM&Co.'s experience that although improved cost and schedule reporting substantially improves the ability to detect problems and take corrective management action surprise overruns are still not eliminated. Eliminating surprise overruns requires a significantly better appraisal of the technical performance status of the project than the government customer has typically had in the past.

To a large extent, technical performance measurement is performed through personal contact between government and contractor technical personnel. This is true both with AFSPPF and other government agencies on both large and small projects. Nonetheless, the effectiveness of technical performance measurement through personal contact is limited by the monitor's workload, the technical complexity of the efforts involved, and the geographic dispersion of the facility's contractors. A contract monitor, responsible for several development projects, may not have time for as much personal contact with each contractor as he would desire.

It is desirable that the contract monitors obtain, from the contractor's report data, the maximum visibility into the technical status of the project. Hence, systematic technical performance reporting in addition to the cost and schedule reporting, is a major contractor reporting requirement.

Objective

At this time, AFSPPF has a technical performance measurement system in which AFSPPF personnel personally evaluate the contractor's technical performance. AFSPPF personnel, and particularly the contract monitors, use "eyeball-to-eyeball" contacts, design reviews, evaluation of test results, and other means to monitor the technical status of the project. However, this form of technical performance measurement is not systematized, is not part of the overall project planning and control system, and may or may not include specific evaluation of technical progress early in the project. PMM&Co.'s objective was to identify and recommend a means of obtaining systematic technical performance reporting that would enable the monitors to identify problems early in the project.

Approach

The overall PMM&Co. technical approach was to develop plans of measurable technical achievement and specify reporting of progress against these plans. The Technical Achievement Plan (TAP) would encompass the following characteristics:

- parameters to be tracked and required specification values;
- development of a plan against which progress would subsequently be evaluated;
- identification of critical parameters to be tracked and their specified values;
- identification, within the TAP, of interim events at which technical performance could be measured.
- identification of technical results expected at these interim technical achievement events;
- maximum use of tests and other objective measurements (e.g., design calculations) as technical achievement events (TAE); and
- identification of sufficient TAE's early in the project.

After such plans have been developed, a technical report would be generated as each TAE occurs. The report would identify and evaluate variances from planned results.

As a result of the PMM&Co. examination of the AFSPPF contract files and discussions with project managers, a format for a TAP that encompasses the above characteristics was derived. The technical performance recommendations described below are based on this TAP format.

Recommendations

The technical performance portion of the PMM&Co. study resulted in four recommendations. These recommendations are as follows:

- develop TAP's for hardware development projects;
- require technical performance reporting against the TAP's;
- require integrated variance analysis; and
- use a modified form of the TAP for study contracts.

The following pages contain detailed discussions of PMM&Co.'s technical performance recommendations.

AFSPPF contractors should be required to use TAP's on major hardware development projects.

The TAP will identify the technical parameters of the equipment or system and their specified value, the interim achievement points (i.e., TAE's) at which progress toward achieving the specified parameter values can be measured, and the value that is expected to be measured at each TAE. A sample TAP is presented as Figure 4.

The first column of the TAP lists the parameters to be measured, and the second column lists the specified value of those parameters. For instance, the specification

PARAMETER	SPEC VALUE	TECHNICAL ACHIEVEMENT EVENTS							COMMENTS
		1	2	3	4	5	6	7	
Precise-Feed Servo Breadboard Complete	Reel Servo Breadboard Test + Complete	Photo Optical Breadboard Tests + Complete	Total Printer Breadboard Complete	Design Review Complete	Sub-assembly Tests	Preacceptance Tests	Final Acceptance Tests		
Printing Rate	"A" prints/sec								
Length of Print	"B" inches								
Print Spacing	"C" mm.								
Resolution	"D" lines/mm								
Illumination Uniformity	"E" mm/sec								
Flash Lamp Stability	See back up document b6/bn								
Logic & Position Control Factors	several - see back up document b6/bn								
Operating Temperature Range	60° - 80° F								
Operating Humidity Range	25-75% humidity								
Configuration	no electrical or mechanical interboards								

FIGURE 4 — TECHNICAL ACHIEVEMENT PLAN

for the printing rate is some number of prints per second. This specification value should be more precisely described in backup documentation. In this instance, there may be more than one mode of operation with different printing rates. Thus, the specification value has to be stated in terms of certain conditions and, in many cases, certain tolerances.

The remaining columns (with the exception of the comments column) show the TAE's. At these events, eight of which have been identified in the figure, progress toward some or all of the listed parameters can be measured. A checkmark indicates that the parameter will be measured at that TAE. For example, at TAE 1, Precise Feed Servo Breadboard Test Complete, the printing rate, length of print, and print spacing can be measured. Furthermore, a check indicates that the value expected at that TAE is the same as the specification value. If, for various reasons, something different than the specification value is expected (possibly as a result of having a breadboard and not the final equipment), then the expected value would be indicated.

A further reason exists for having something other than the checkmark in one of the boxes. This is the situation where the test is for something other than the specification value itself. For instance, at TAE 2, Reel Servo Breadboard Test Complete, transport rate and stability will be tested rather than the printing rate. Detailed explanations of these events should be described in backup documentation.

Diagonal lines are drawn in each box where technical performance measurements will be made so that the planned value can be put in the upper left corner and, when reports are submitted, the achieved value can be entered in the lower right corner. In this way, the TAP becomes a dual-purpose document that can be used for both technical achievement planning and reporting.

Technical performance reporting against the technical achievement plans should be required.

Once the TAP's described above have been developed by the contractor and approved by the government, the contractor

will report technical performance achievement against the plan. Two kinds of reporting will be required. First, a report will be required whenever a TAE occurs, and, second, periodic reports will be submitted with periodic cost and schedule reports.

The reports submitted when a TAE occurs will include the TAP and an accompanying narrative report. The TAP will show in the lower right corner of the appropriate boxes the value achieved for each test. Since this number by itself may be of limited value, the contractor should also submit accompanying narrative documentation that expresses more fully the test results. This documentation will include what was achieved, the confidence in the numbers that were achieved, and the implications of the test results. Where variances exist, their cost, schedule, and technical impact will be discussed. Corrective management action being taken and any management action the contractor feels the government should take should be included.

For the periodic reports, the technical performance status can be included in the R&D Contract Status Report/Narrative (see DID I, Appendix A) and should be accompanied by the latest edition of the TAP.

Contractors should be required to perform an integrated variance analysis.

The full effectiveness of the TAP, and subsequent reporting, is not realized unless the contract monitor is able to analyze his cost, schedule, and technical performance reports together to identify root problems.

Technical Achievement Plans should be used on study contracts with some modification.

The TAP's described above usually would not be appropriate to a study contract, because the contractor is not required to produce a product with specific performance requirements. The study contract usually consists of a number of subobjectives that do not have a specified numerical value. For example, a typical study may be broken down into the following subobjectives:

- define duplicate quality;
- develop objective means of measuring quality;
- develop criteria to rank the quality of samples;
- determine statistically the best objective quality indicator.

In the TAP for a study, a list of subobjectives may be more specifically defined than is done in this example. TAE's that are appropriate to these objectives can then be identified. Typically, these would not be test events. More likely, they would be the major milestones of the study that would be included in the milestone report. The TAP then could designate the milestones at which formal project reviews would be held. The contract monitor would identify what information should be made available for these reviews, the technical aspects of effort to be considered, and what results are expected from the reviews.

The TAE's on a hardware contract were defined to be objective measures of technical achievement. However, it is usually not possible to develop such measures for study contracts. Hence, the TAE's for a study contract will generally be subjective rather than objective measures. Where objective TAE's on a study contract can be defined, they should be used. For these study programs, technical performance reporting would take place, as for the hardware programs, when the TAE occurred. Overall technical status to date would be incorporated with the periodic cost and schedule narrative reports.

Implementation

To a large extent, the exact nature of the TAP and the steps in its implementation are a function of the particular project. The longer, larger (in cost), and more complex the development program, the more appropriate a TAP. However, the TAP can be used with hardware developments of almost any size. For small programs, the plan might not

include much more than a listing of the contract specifications, their values, and one or two interim points at which these can be measured. In general, some form of a TAP can be used for any hardware development effort in which the contractor is charged with developing equipment to meet contract specifications.

Modification of the TAP's, as discussed in the last recommendation in this section, can be used to formalize the planning and control of study contract work efforts. Such TAP's should usually be of assistance on study contracts that cost \$50 thousand or more and that last at least three months.

Technical Achievement Plans and reporting are not felt to be appropriate for services contracts and for the purchase of off-the-shelf equipment. Additionally, in working with the contract monitors to test the validity of a TAP for a software development, it could not be verified that technical achievement plans would be useful. For the particular contract studied, there was no equivalent to the test events that would serve as an interim measure of technical performance, and there were no detailed specifications to describe the project.

Implementation of technical achievement planning and reporting has several steps that are common to both development and study contracts. These are the following:

- Inclusion of the technical achievement planning and reporting requirements in the Request for Proposal, or its equivalent.
- Description by the contractor, in his proposal, of how he will specifically meet the government's planning and reporting requirement.
- Submission by the contractor, shortly after contract award, of a Technical Achievement Plan.
- Approval by AFSPPF of that plan.

- . Submission by the contractor of subsequent reports against the plan. (The plan would be changed only when there was a corresponding contract change.)

With this mode of operation, the contractor is allowed to develop his own plan, but the government has the right of approval. Thus, the monitor has an opportunity to ensure that the contractor has met the government's requirement.

Since TAP's and reports are data requirements, they must be included on the "Contract Data Requirements List," DD Form 1423. This can be done by using data item S-117, "Technical Reports," from the ADL in AFSC/AFLC Manual 310-1. The specific requirements for the plans and reports would be included in the statement of work as referenced on the DD Form 1423.

The recommendations made for technical performance planning and reporting should place no significant burden on AFSPPF contractors. They may require a contractor to reformat his plans and deliver them to the government, which he has not been required to do in the past. Nonetheless, the requirements involve nothing over and above effective engineering management. Thus, the contractor should not have significant difficulty in implementing the requirement, nor should it cost him a significant amount of money to implement such a system.

VI. MANAGEMENT INFORMATION SYSTEM RECOMMENDATIONS

This section, addressed to Paragraph 4.3 of the contract statement of work entitled "Develop Management Information System," presents recommendations for improving the use of contractor reporting data within AFSPPF.

Statement of Problem

AFSPPF's research and development activities involve the management of a number of relatively small contracts. These contracts involve a number of technical disciplines, contractors, procuring agencies, etc. It is sometimes difficult for facility personnel to keep apprised of the status of each of the efforts in which they are interested.

While this problem exists for those individuals interested in only a few of the contracts, the problem is magnified for those persons involved in the entire R&D activities of AFSPPF. In particular, the Commander and his staff, the Director of Research and Development, and the Management Operations Officer are required to be familiar with all of the technical facility's efforts. This familiarity is required because of the frequent command decisions necessary concerning R&D matters, and the continual interfacing of the individuals mentioned with other related organizations. A large amount of contractual data is available at AFSPPF because it is required by contract monitors to effectively manage their efforts. Because so much data is available, no one person in the facility can have a detailed knowledge of all the data relevant to all of the contracts. Hence, contract data must be made available in summary form to support R&D management decision-making at AFSPPF.

It is also important to note that AFSPPF's primary research and development mission is not only to effectively manage R&D contracts. The facility has a broader mission in that it must accomplish certain technical objectives (i.e., design and development of a state-of-the-art hardware device) in support of an operational requirement. The contractual effort is only one aspect of achieving the objective,

although a major one. The facility must also identify and define a requirement, develop ways to meet the requirement, initiate a procurement action, manage a contract, carry out test and evaluation programs, and oversee the installation of the equipment. Hence, decision-making in the R&D area must always be performed with the technical objective in mind, in addition to the specifics of any particular contract. Contractor performance data must be used so that it supports the accomplishment of the technical objective, in addition to the management of the contract.

Approach

PMM&Co.'s original approach to improving the communication of contractor performance data within AFSPPF was to create a management information center (MIC). A MIC would consist of a number of wall charts containing contractor performance data, in summary form, and any other administrative data relevant to contract performance (e.g., funding). Thus, all relevant contract data would be available in quickly understood format. This set of charts would serve as the principal means of communicating contractor performance data to the Commander and would provide a framework for making contract-related decisions.

PMM&Co.'s studies have indicated that this approach is not appropriate for AFSPPF use due to the small size of the contracts involved and the active role taken by AFSPPF command personnel in the R&D area. In particular, the facility Commander frequently interfaces with higher authority and other organizations on R&D matters. This interfacing requires him to have, readily at hand, detailed information on the status of many R&D projects. Hence, an MIC could only contain summary data and would not be transportable. The Commander would probably be familiar with more detailed data on a number of the projects than was available in the MIC. Further, an MIC that consists of charts would require significant effort to create and maintain, thus potentially reducing the frequency of updating which, in turn, would reduce the timeliness of the data presented.

Since the MIC approach was not felt to be appropriate, PMM&Co. broadened the scope of its inquiries in the management

information systems area. In particular, PMM&Co. looked at how facility personnel use contractor performance data in contract management, and how this data is used in the accomplishment of technical objectives at AFSPPF.

Objective

In light of the above findings, the objective of PMM&Co.'s task was to make practical recommendations to improve the way AFSPPF uses contractor performance data in R&D management. In particular, these recommendations should assist the contract monitor in his efforts to effectively manage an R&D contract; should improve the way in which data is made available to AFSPPF command personnel to support their management requirements; and should emphasize the facility's broad R&D mission of accomplishing a technical objective in response to an operational requirement.

Recommendations

Four recommendations in the management information systems area are discussed below. These relate to the management role of the contract monitors, use of work plans by the monitors, an alternative to an MIC, and planning of a number of technically related contracts.

The contract monitors' full responsibility for meeting the cost, schedule, and technical objectives of a contractual effort should be reaffirmed.

AFSPPF contract monitors have a wide range of authority and responsibility in regard to contractual matters. At times, considering the involvement of command personnel and Air Force procurement agencies in AFSPPF R&D activities, the extent of these responsibilities is not entirely clear. While the contract monitor does not have the authority to make the major decisions relating to a contract (such as whether to accept a proposal or terminate an effort), he does have responsibility for the overall management of the effort. Further, this responsibility includes all aspects (i.e., cost, schedule, and technical) of contractual performance.

AFSPPF command personnel should reaffirm that it is the monitor's responsibility to take the primary role in the management of an effort, whether this involves presenting alternatives, with recommendations to the Commander for a decision, or taking initiative on his own part. In fact, recommendations concerning contractor performance data reporting have been made to support the management activities of the contract monitor. If the monitor does not understand or accept the full range of his responsibilities, effective contract management at AFSPPF will not be possible.

The responsibilities of the contract monitor are, as has been stated, managerial in nature. Hence, the term "contract monitor" is somewhat of a misnomer, and would appropriately be changed. The term "project manager" or "project engineer" would be more descriptive of the monitor's responsibilities.

The use of work plans by contract monitors on contracts or technical efforts should be required.

As described above, the contract monitor has cost, schedule, and technical responsibility for the contractual effort. However, the facility's R&D mission has been more broadly defined to include the accomplishment of a technical objective in response to an operational requirement. This includes a number of activities, such as managing a procurement action or carrying out a test and evaluation program, in addition to the specific contract activities. Since the monitor also has responsibility for these broader technical objectives, he should have plans showing how the technical objective is to be met. These "work plans" would serve the following functions:

- provide a baseline against which to measure accomplishment of the technical objective that will meet the operational requirement;
- reemphasize the monitor's responsibility for meeting the technical objective, in addition to his cost, schedule, and technical responsibility for the specific contractual effort;

- provide a framework for making contractual decisions, such as extensions, scope changes, etc.;
- provide a formalized means of communication between contract monitors and AFSPPF command personnel.

The content of the work plans will vary depending upon the nature of the effort involved. Typically, they would consist of two to four pages of written material plus exhibits. The work plans would include the following data:

- the requirement that the contract effort is to meet (i.e., a statement of the problem);
- the technical objectives or the performance specifications needed to meet the requirement;
- schedules (both contractor and AFSPPF activities);
- cost (expected and acceptable; i.e., if the contractor's proposal was for twice as much money as was expected, would it still be accepted);
- high risk areas (technical, cost, or schedule);
- management approach (including data requirements, review meetings, and support requirements from other AFSPPF personnel);
- the decisions required by the Commander, with dates.

Work plans should be written by the monitors and updated periodically, probably quarterly, for most contracts. The work plans would be reviewed and approved by the Director of Research and the facility Commander. Since the plans should assist contract monitors and supplement interpersonal management, they will not be standardized. They should be adjusted to meet the particular requirements of the effort in question.

In addition to the use of work plans, one other device may be of assistance to the contract monitors. This is the periodic report review checklist that is shown as Figure 5. This checklist would serve as a guideline to the monitor when reviewing contractor reports. In addition, it would provide a convenient way to record his comments on and action taken in response to the reports. The annotated checklist could be circulated with the contractor report so that other facility personnel will see the report and the monitor's comments together.

A Management Information Notebook should be used as a practical alternative to a management information center.

Because of its inflexibility and updating workload, an MIC was not recommended as a means of communicating contractual data to the AFSPPT Commander. A Management Information Notebook (MIN), with two pages of data on each contract, would be a practical alternative to an MIC. Formats for the data are shown in Figures 6a and 6b.

The MIN would contain summary data on the facility's R&D contracts, with emphasis being placed on the technical objective of the effort. This data will provide the Commander with a historical framework within which to evaluate program status and make program decisions. In particular, the charts would contain the following data:

- identifying information;
- description of the effort and requirement to be met;
- schedule data, including the date the facility must have the output of the effort;
- technical risk areas;
- cost sensitivity (e.g., would the equipment still be procured if a significant overrun occurred?);
- summary of review meetings;

Figure 5

SAMPLE REPORT REVIEW CHECKLIST

REVIEW SHEET: PERIODIC CONTRACT STATUS REPORT	
I. Report Covers (date): When Rec'd: Timely?:	Title:
II. Report Meet DD 1423/1664 Req'mts	Contractor:
	Contract No.:
	Area:
	Dates:
	Period Covering:
III. Variances/Problems (identify problems, impact, and action required):	
A. Technical:	
B. Cost:	
C. Schedule:	
IV. Government Actions Required:	
V. Estimates To Complete (monitor's estimate of completion date, cost, and performance; does this vary from contractor's estimate; is this acceptable?):	
VI. Overall Evaluation of Contractor Performance:	

AREA: Quality Control	TITLE: Spectrum Analyzer	CONTRACTOR: X,Y,Z CORP.	CONTRACT NO: F-2210-72-981 (CPFF)	DATES: Jan 70 - Mar 71	MANAGER: Joseph Schmidt
DESCRIPTION OF EFFORT AND REQUIREMENT TO BE MET:					
<p>The objective of this effort is to increase the capabilities of our quality control efforts. The benefits to be gained are 1) reduction of quality control manpower and 2) earlier identification of rejects. While not critical to mission accomplishment, the spectrum analyzer should pay for itself in two to three years. Under this contract, an off-the-shelf analyzer will be modified to increase its sensitivity and enable it to handle production quantities of our product.</p>					
RESULTS OF REVIEW MEETINGS:					
<p>Initial discussions with Mr. Schmidt, Project Manager, and Mr. Y.Z. Corp. have been completed. The discussions have been very positive. The contractor's interest in the program environment was also expressed. It is anticipated that the contractor will be able to meet the original objectives in future.</p>					
SCHEDULE:					
<ol style="list-style-type: none"> 1) Proposal Submitted 2 September 1969 2) SOW Complete 17 Oct 1969 3) Contract Effort: Start, Finish Jan 70 - Mar 71 4) Contract Review Dates Mar, Jun, Sept, Dec 70, Mar 71 5) T&E: Start, Finish Apr 71 - Jun 71 6) Req'd Date by AFSPPF Not Mission Critical 					
TECHNICAL RISK AREAS:					
<ol style="list-style-type: none"> 1) Reliability in Production Environment 2) Sensitivity 					
COST SENSITIVITY:					
<p>This equipment is being procured to increase the efficiency and therefore decrease the cost of the production operation. If contract costs rise significantly, the equipment may no longer be a good investment and procurement should be terminated.</p>					

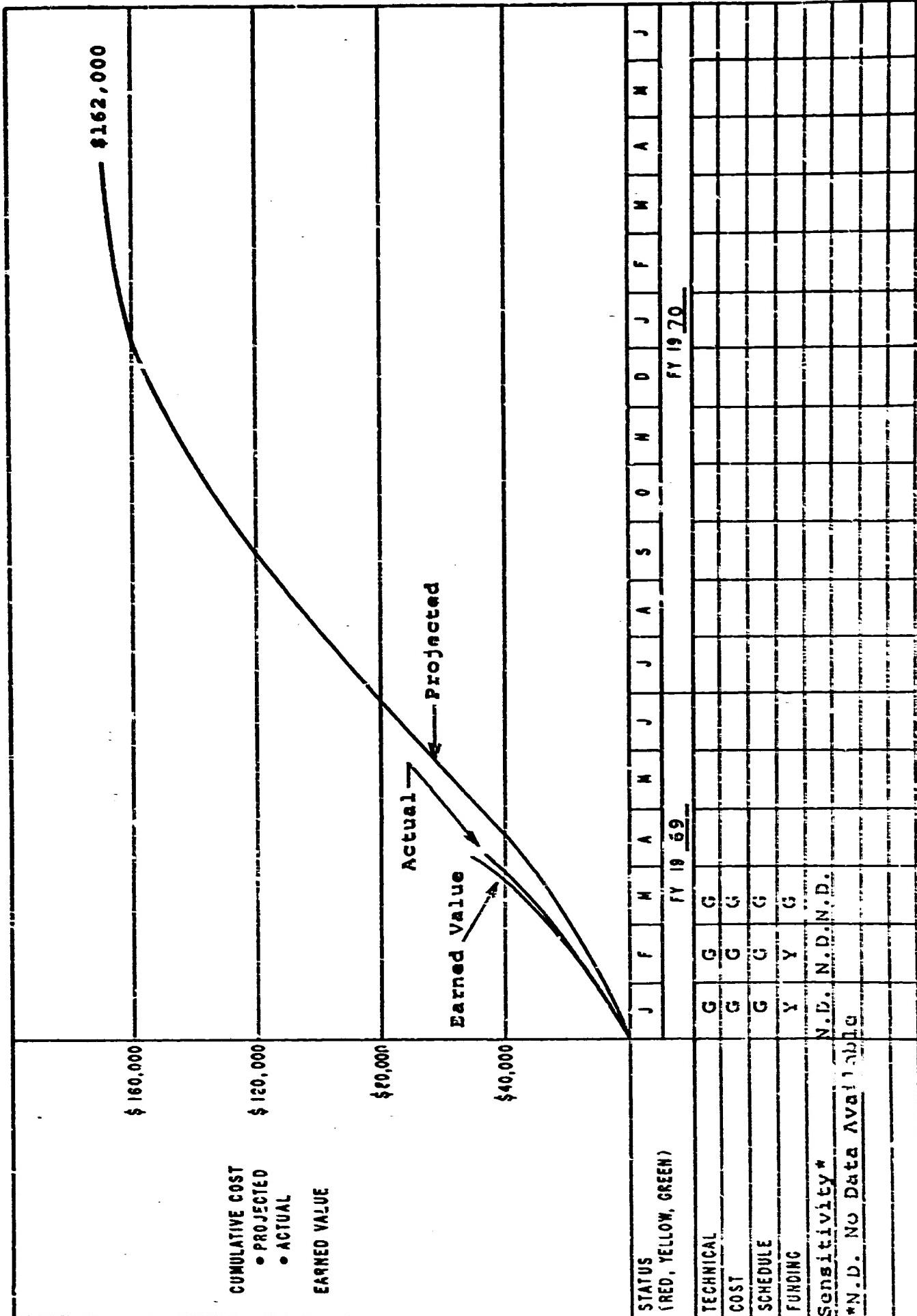


FIGURE 6B - MANAGEMENT INFORMATION NOTEBOOK FORMAT

- . financial data, including projected and actual costs and earned value;
- . status information by month (the status of a number of contract parameters can be tracked monthly with red, yellow, or green pencil; blank spaces are provided below the parameters shown so that any other items of importance to a particular contract can be inserted).

Since there would only be two pages of data per contract, the MIN would be small and relatively easy to keep current. Thus, when the facility Commander travels, he could take the notebook with him.

The contract monitor would have the responsibility for filling out and updating the charts for his projects. This should not be burdensome, since most of the data on the charts will come from the monitor's work plans. The Management Operations Officer should have general responsibility for maintaining the MIN.

The MIN should supplement the facility's present weekly R&D briefings, as opposed to replacing them. The focus of the weekly briefings is on updating recent changes in contract status and providing for information transfer on R&D matters among facility personnel. The MIN, on the other hand, has a longer term orientation because its focus is on the technical objectives of the effort, which places contract performance in a historical context.

When a number of AFSPPF contracts lead to the same technical objective, planning should be performed on a technical area basis.

Most AFSPPF R&D contracts are somewhat independent in that problems with one do not directly affect the performance of others. Presently, however, AFSPPF is engaged in efforts in one "technical area" that includes the efforts of a number of contractors, both on fixed-price and cost-reimbursable efforts. These efforts require significant interfacing between the contractors and between contractor

and AFSPPP personnel. When such a situation exists, it is important that the planning and managing of the efforts involved are done as a whole, since problems with one effort could affect the others.

Efforts recently made to perform such technical area planning have had positive results. If other areas of technical effort requiring a number of contractual actions develop, planning should be performed on the area basis. This planning should include required AFSPPP activities in addition to contractor tasks, and the interrelationships between AFSPPP and contractor tasks.

VII. SUPPLEMENTARY RECOMMENDATIONS

In the course of FMM&Co.'s effort on this contract, three recommendations were developed which concerned the relationship between AFSPPF and its contractors. These recommendations, which are supplementary to the contractual statement of work, are summarized below.

1. The facility should avoid concurrent cost-reimbursable and fixed-price contracts with one contractor in technically related areas.

If a contractor has two contracts with AFSPPF at the same time, one fixed price and one cost reimbursable, he may be tempted to charge some of the costs of the fixed-price effort to the cost-reimbursable effort. Whenever possible, the facility should avoid this situation by either delaying the efforts or making the two efforts one contract. When this is not possible, the contractor's charges to the cost-reimbursable contract must be closely reviewed to ensure that they belong to that effort.

2. The facility should insist that all cost-reimbursable contracts have limitations on the overhead and general and administrative rates.

AFSPPF contractors have, in a number of instances, experienced large increases in overhead (O/H) and general and administrative (G&A) rates. These increases have caused significant overruns on facility contracts because O/H and G&A typically represent 50 percent of the total contract cost. For example, the contractor's cost estimates on a recently initiated program were as follows (figures are approximate):

Direct Labor	\$ 37,000
O/H (81%)	30,000
Direct Costs	
Consultants	1,600
Travel	1,200
Materials	<u>3,400</u>
	<u>6,200</u>
Total Research Costs	73,200
G&A (25%)	<u>18,300</u>
	91,500
Fee	<u>7,500</u>
TOTAL COST PLUS FIXED FEE	<u>\$ 99,000</u>

In this example, O/H and G&A accounted for \$48,300, which is approximately 50 percent of the total cost plus fixed fee. If the O/H and G&A rates go up 10 percent on this contract, an overrun of approximately 5 percent will be incurred (since O/H and G&A are one-half of the total costs). If the O/H and G&A rates are higher, the potential overrun can be much greater.

This problem can be avoided by placing "limitation of overhead rate" clauses in the facility's contracts. In many instances, contractors will probably not want to accept such clauses. However, contractors that have that attitude are probably anticipating rate increases, making the clauses all the more desirable for AFSPPF.

3. AFSPPF personnel should take an active role in contract negotiations.

Many contractual matters (e.g., cost rates, data requirements, and personnel to be used by the contractor) are decided during contract negotiations. At this time, the government has the greatest leverage in determining the nature of the effort. Since AFSPPF personnel are more familiar with the facility's requirements than

personnel in the procuring agencies, they should work closely with the procurement personnel to ensure that the facility's requirements are met. Facility personnel should also understand that all contractual matters are the subject of negotiations before the contract is signed and, at that time, should take full advantage of their prerogatives to gain favorable contract terms.

Appendix A
DATA ITEM DESCRIPTIONS

This appendix contains five data item descriptions (DID) to be used in the implementation of the recommendations made in this report. These DID's are as follows:

- I. R&D Contract Status Report/Narrative
- II. Program Schedule/Milestone Accomplishment
- III. Cumulative Cost Projection/Report
- IV. Milestone Costing Plan/Report
- V. Task Valuation Plan/Report

I. R&D CONTRACT STATUS REPORT/NARRATIVE

A. DESCRIPTION/PURPOSE

The R&D Contract Status Report/Narrative is designed as a periodic, recurring report to keep management informed of: (1) the progress made on R&D contracts during the previous reporting period; (2) any problems encountered which will have an impact on the cost, schedule, or technical objectives of the effort; and (3) any requirements for action by the government.

B. APPLICATION/INTERRELATIONSHIP

The report will be used on cost-reimbursable contracts in the R&D area. It may be used on fixed-price contracts with the deletion of cost data. When more sophisticated reporting is required, the narrative report will serve as the textual portion of the entire report. The narrative section will introduce the other data items and provide any detailed explanations required.

C. PREPARATION INSTRUCTIONS

1. Format

The report will be written according to the following outline, with additional sections added as required:

- I. HIGHLIGHTS
- II. GOVERNMENT ACTIONS REQUIRED
- III. TECHNICAL PERFORMANCE
- IV. SCHEDULE
- V. COST
- VI. CONTRACTUAL

The reports should be brief, but not incomplete. Where clarity will not be lost, outline format will be acceptable. If it is desirable to include a quantity of data in one area, exhibits should be used.

2. Content

The report sections outlined above should contain, as appropriate, the following information:

- . HIGHLIGHTS - All reports longer than one or two typewritten pages will have a highlights section. This section will be one-half page or less and will outline the major points to be made in the report.
- . GOVERNMENT ACTIONS REQUIRED - Any government actions required in the next reporting period, or overdue from past reporting periods, or new requirements for future periods will be listed.
- . TECHNICAL PERFORMANCE - The following will be included:
 - . description of approach and progress during the reporting period, supported by reasons for any change in approach reported previously, including a discussion on the effect of any changes on the accomplishment of the contractual objectives;
 - . description of any major items of experimental or special equipment purchased or constructed during the reporting period.
 - . notification of any changes in key personnel associated with the contract during the reporting period;
 - . summary of substantive information derived from noteworthy trips, meetings, and special conferences held in connection with the contract during the reporting period;
 - . other accomplishments; i.e., scientific papers published, etc.
- . SCHEDULE - The following will be involved:
 - . statement of schedule (milestone) achievements;

- . explanation of any rescheduling of contractual efforts (original schedule will always be shown);
 - . estimate of the completion date of the contract and the next significant milestone.
- . COST - The following will be involved:
- . statement of funds expended to date;
 - . statement relative to the apparent sufficiency of contract funds to achieve the objective of the contract;
 - . explanation of any variances between planned and actual expenditures;
 - . statement of any variances in cost buildup data from plan (including direct labor rates, overhead rates, general and administrative rates, labor hours, materials costs, etc.).
- . CONTRACTUAL - All contractual matters (such as submission of CCN's, etc.) that arise during the contract should be detailed in this section. These items may be the subject of other correspondence, but they should also be included in this section.

III. PROGRAM SCHEDULE/MILESTONE ACCOMPLISHMENT

A. DESCRIPTION/PURPOSE

The Program Schedule/Milestone data item portrays: (1) the phases, major milestones, and tasks of the effort required to meet the contractual objectives; and (2) the significant program progress made by the contractor between reporting dates.

B. APPLICATION/INTERRELATIONSHIP

This data item is applicable to most R&D efforts, including hardware development, software development, and studies. It can also be used on fixed-price contracts if schedule data is required by the government for effective management of the program. This report should always be accompanied by DID I, R&D Contract Status Report/Narrative, which will provide a narrative explanation of program plans and progress. When more sophisticated reporting, which includes program schedules and milestone accomplishments, is required (see DID IV, Milestone Costing, and DID V, Task Valuation) the guidance in DID II should be followed.

C. PREPARATION INSTRUCTIONS

1. The contractor will prepare Milestone Reports using AFSC Form 103 (see Exhibit 1), showing schedules expressed in terms of (a) phases, which cover spans of time, and (b) milestones, which are actions or accomplishments that can be scheduled for a specific point in time and evaluated on the basis of actual accomplishment. These schedules will be shown as realistically as can be estimated at the time of preparation.

2. This data item may be prepared in the contractor's own format, if it is equivalent to AFSC Form 103. In any case, the charts should be clear and have a scale as large as the normal form size will permit. As the technical effort progresses, if the schedules are changed, the original schedules will always be shown.

3. Slippages, or other discrepancies between planned and actual accomplishment, and reasons for changes in forecasts will be supported in the accompanying data item, R&D Contract Status Report/Narrative.

EXHIBIT 1
AFSC FORM 103

"FORGING MILITARY SPACE POWER"

PROGRAM SCHEDULE	SYSTEM (Project) NUMBER	SUBSYSTEM	TYPE OF ACTIVITIES OVERALL APPROX DATE											
			PRIOR PENIOD	FY 18	FY 19	FY 20	FY 21	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D
1	SPEC OPERATIONAL ROMT NO. 2													
2	PSPP APPROVED													
3	SYSTEM PROGRAM DIRECTIVE													
4	CONTRACT AWARD													
5	PRELIMINARY MODEL SPEC													
6	DEVELOPMENT ENG. INSPECTIONS													
7	MOCKUP INSPECTIONS													
8	CONTRACTOR TO COMPLIANCE INSPI													
9	FIRST SIGNIFICANT ACHIEVEMENT													
10	START CAT I TESTING													
11	END CAT I TESTING													
12	START CAT II TESTING													
13	START CAT III TESTING													
14	OPERATIONAL DATE													
15	PRODUCTION DELIVERY													
16	TRAINING													
17	FACILITIES-PLANT X (AIRFRAME)													
18	FACILITIES-PLANT Y (ENGINE)													
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														
35														
36	AUTHENTICATION													

AFSC FORM 103

PREVIOUS EDITION OF THIS FORM WILL BE USED UNTIL STOCK IS EXHAUSTED.

AFSC-AAPD WASH DC

III. CUMULATIVE COST PROJECTION/REPORT

A. DESCRIPTION/PURPOSE

The objective of the Cumulative Cost Projection/Report is to: (1) provide a projection of contract costs, graphed cumulatively over time; and (2) provide for the periodic reporting of the actual costs incurred on the contract for comparison with the projection. Provision is also made in the data item format for inclusion, in tabular form, of more detailed contract performance data.

B. APPLICATION/INTERRELATIONSHIP

This data item can be used on a wide range of contracts in the R&D area, except for firm-fixed-price contracts. It will often be used in conjunction with DID II, Program Schedule/Milestone Accomplishment, to provide cost data for program evaluation.

C. PREPARATION INSTRUCTIONS

1. At the beginning of the contractual effort, the contractor will prepare a projection of cumulative costs to be incurred during the contract using the Cumulative Cost Form, presented as Exhibit 2, or the contractor's equivalent. The rows for additional data will be used if it were instructed to do so on DD Form 1423, "Contract Data Requirements List."

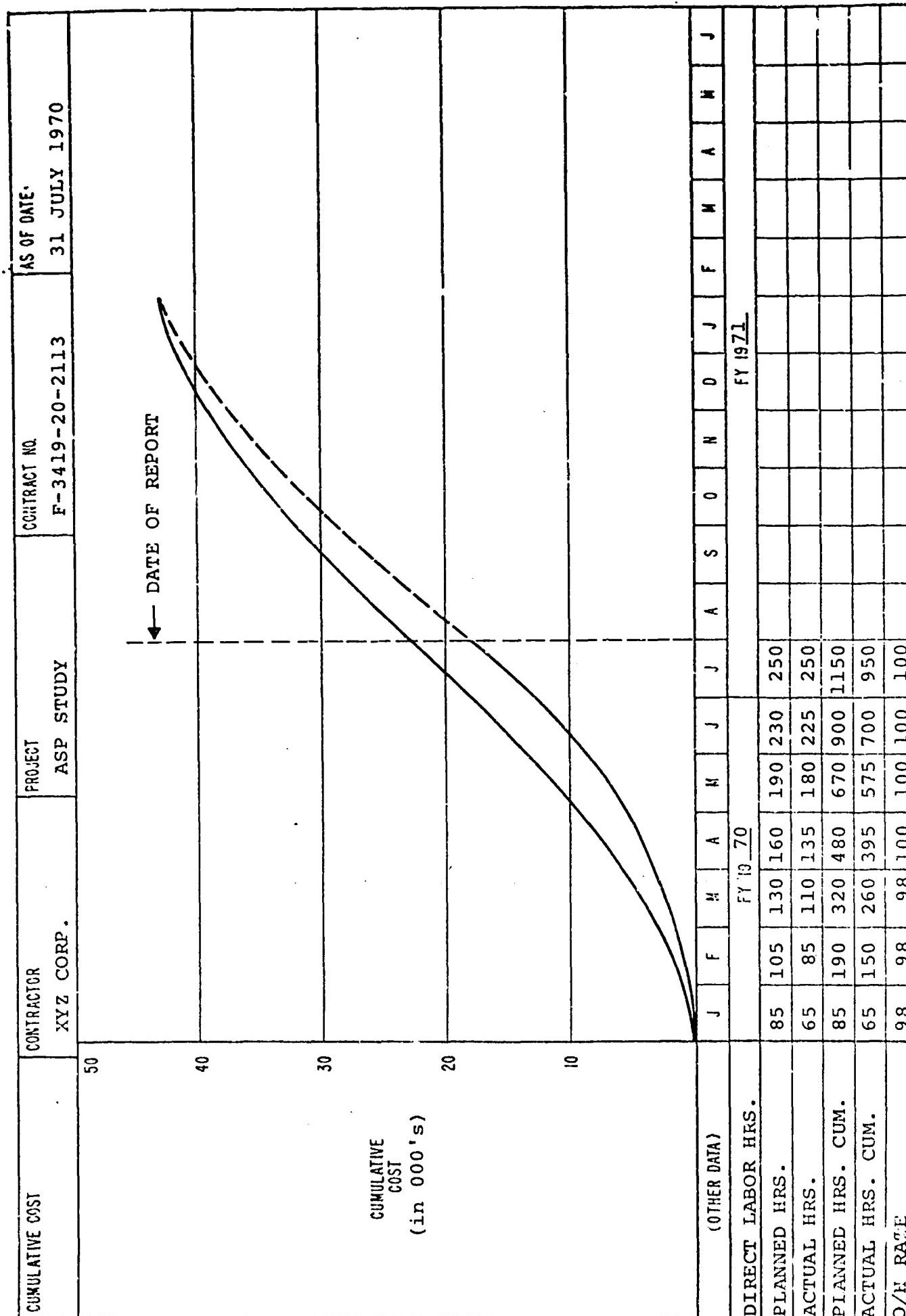
2. The contractor will submit periodic updates of the Cumulative Cost Form showing actual contract costs. The frequency and dates of submission of these updates will be given on DD Form 1423. These updated reports will always include an estimate to complete of the actual expenditures curve. This estimate to complete will be the contractor's latest estimate of the cost to complete the work not yet done, the completion date, and how the costs will be expended as a function of time.

3. Total costs, unless otherwise indicated on DD Form 1423, will be defined as total contract costs,

excluding fixed fee. Total costs will include direct labor, overhead, materials, subcontract costs, travel, etc.

4. The contractor will not change the original projected cost curve unless specific permission has been granted by the responsible Air Force authority. The estimate to complete, however, will only be shown for the latest period.

5. When this data item is used as a plan of contract costs over time, in addition to a report, more detailed cost buildup may be required. The cost of each contract task will be given and broken down into direct labor, overhead, materials, travel, and general and administrative categories. The rates and assumptions used in making the cost buildups will be clearly identified.



IV. MILESTONE COSTING PLAN/REPORT

A. DESCRIPTION/PURPOSE

Milestone Costing is a method of directly associating planned expenditures of contract funds with the scheduled completion of contract milestones. Comparison of the actual and planned costs when a milestone is completed will provide a measure of the earned value of the contractual effort.

B. APPLICATION/INTERRELATIONSHIP

This data item will be applicable to R&D contracts which have a number of intermediate milestones and tasks which do not greatly overlap. It should not be used on contracts which require more sophisticated reporting, such as DID V, Task Valuation. Such a contract would be one in which the individual tasks were concurrent in time, since a number of tasks would be in process at each milestone. Since Task Valuation estimates the value of work in process, whereas Milestone Costing does so less precisely, Task Valuation would be appropriate for these contracts.

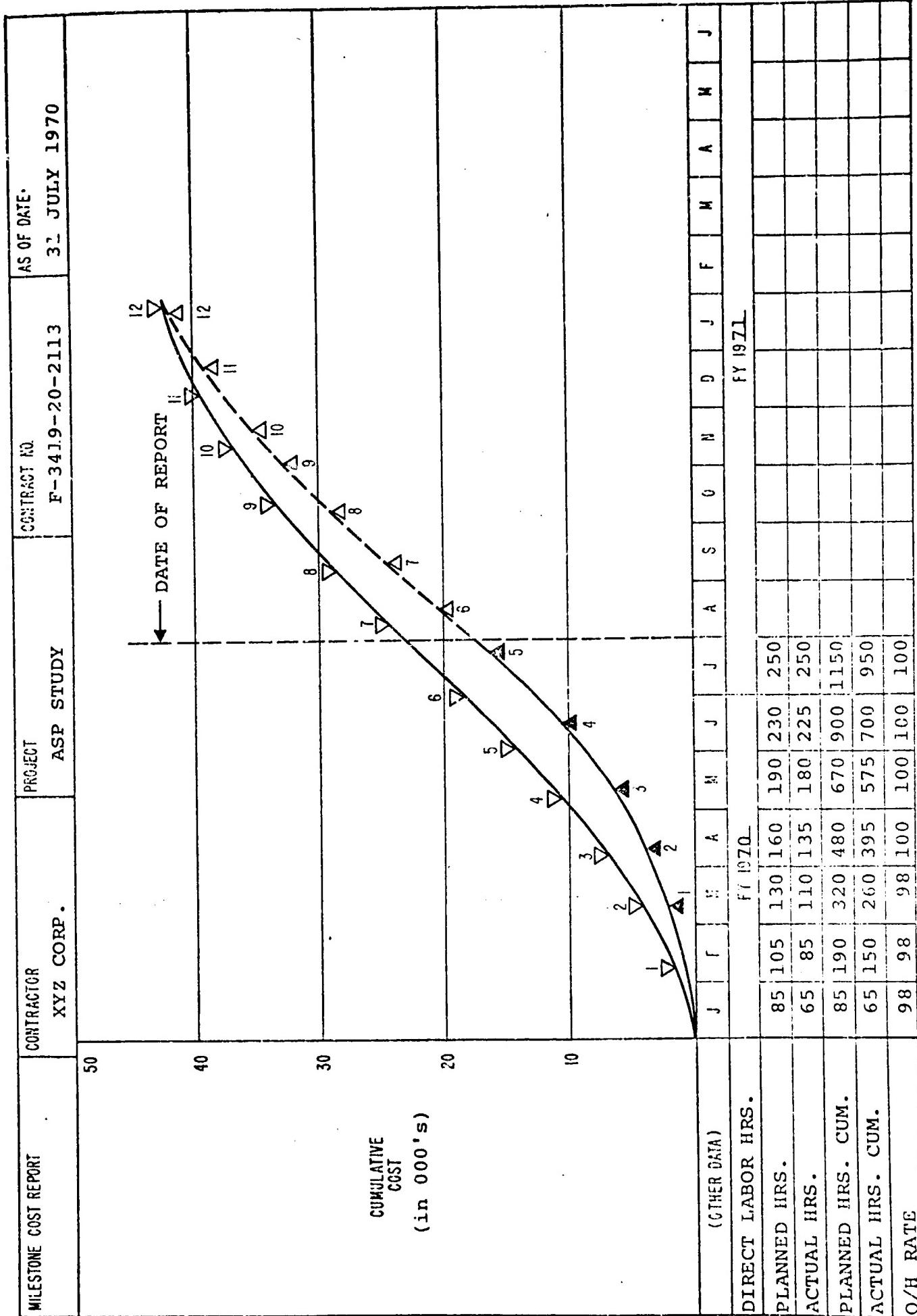
C. PREPARATION INSTRUCTIONS

1. The contractor will prepare a Program Schedule and Cumulative Cost Projection as outlined in DID's II and III. These two plans should not be constructed independently. The Cumulative Cost Projection should be developed by summing the expected costs of each of the tasks in the Program Schedule. When the Cumulative Cost Projection has been completed, the milestones from the Program Schedule should be placed on the cost curve (see Exhibit 3). The milestones should be numbered for easy reference to the Program Schedule.

2. As effort on the contract progresses, actual expenditures are graphed, and actual completion of milestones are shown on the actual cumulative expenditure curve. Each time a report is submitted, a projection to completion of both milestones and costs should be included (see Exhibit 3). The Program Schedule/Milestone Report should also be updated each reporting period.

3. The guidance given for preparing and submitting the Program Schedule/Milestone Report and the Cumulative Cost Projection Report, DID's II and III, should be followed except when it conflicts with the above instructions.

4. Contractor equivalent forms may be used to increase clarity of the reports or to reduce preparation costs.



V. TASK VALUATION PLAN/REPORT

A. DESCRIPTION/PURPOSE

The Task Valuation Plan/Report is a method of developing a relationship between the cost and work performance plans of a contract so that the expected cost of each contract task/activity is identified. Progress reporting against this plan is then accomplished by reporting milestone accomplishments, costs incurred, and the percent complete for each of the contract tasks/activities.

B. APPLICATION/INTERRELATIONSHIP

This data item will be applicable to R&D contracts which consist of a number of identifiable tasks. It should also be useful on study and software contracts if there are enough tasks in the contract, the tasks are not greatly overlapping in time, and the milestones defining the start and finish of the tasks are well defined.

This data item description relates milestone planning/reporting to cumulative cost projection/reporting and allocates the total contract value to the individual tasks. Hence, the requirements of milestone reporting (DID II) and cumulative expenditure reporting (DID III) apply to the Task Valuation Plan/Report except where specific changes are noted.

C. PREPARATION INSTRUCTIONS

1. The contractor will prepare a Milestone Schedule as he would if complying with DID II. However, he will use the format shown in Exhibit 4 which has the additional column "% complete." When submitting the TV report as a plan at the start of the contractual effort, the projected cost of performing each task shown will be entered in this column. When reports are submitted, the contractor will evaluate the percent complete for each of the tasks and enter the values in the column. (See note for an explanation of percent complete.)

2. The contractor will also prepare an estimated cumulative cost curve (DI. III) at the beginning of an effort. The projection will be updated with actual cost data and submitted with the milestone schedule shown in Exhibit 3.

3. It is important that the "as of date" be both the date to which the estimates of percent complete apply, and the date through which expenditures are reported.

NOTE: Estimates of the percent complete of each task should be made by the individual directly responsible for the performance of the effort. The estimate should be based on the resources (man-hours, materials, etc.) which have been expended on the effort and that are estimated to be required to finish the task. For instance, if an engineer estimates that 50 hours have been expended on a design task, and 50 additional hours will be required, the task is 50 percent complete, even if the original estimate for the task was 75 hours. The estimates should be based on the efforts required to complete the tasks, and not on the original estimated cost of the effort.

EXHIBIT 4 - TASK VALUATION CHART

PROGRAM SCHEDULE/TASK VALUATION		CONTRACTOR	PROJECT	CREDIT CONTRACT NO.	AS OF DATE																							
		XYZ Corp.	ADE-492	F-2261-14-2130	April 31, 1970																							
LINE	TASK / MILESTONES	% COMPL.	FY 1970												FY 1971													
			J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	F	M	A	N	J		
1	Breadboard Design	100																										
2	Breadboard Tests	100																										
3	Equip. Interfaces Design	50																										
4	"A" Equip. Schematics	15																										
5	"B" Equip. Schematics	25																										
6	Mechanical Layout	25																										
7	Eng. Model Fabrication	0																										
8	Bench Tests	0																										
9	Environmental Tests	0																										
10	Subsystem Assembly	0																										
11	Subsystem Tests	0																										
12	System Tests	0																										
13	System Installation	0																										
14																												
15																												
16																												
17																												
18																												
19																												
20																												
21																												
22																												
23																												
24																												
25																												
26																												
27																												